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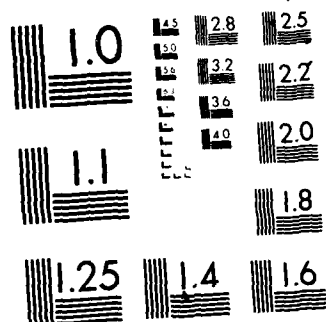
AUTOMATED MECHANICAL TEST AND ENVIRONMENTAL CONTROL
EQUIPMENT AND DATA AC. (U) FLORIDA UNIV GAINESVILLE
DEPT OF ENGINEERING SCIENCES L E MALVERN ET AL.
24 MAY 86 AFOSR-IR-86-0889 AFOSR-83-0293 F/G 14/2

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REPORT DOCUMENTATION PAGE

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| <p>This report identifies equipment actually acquired under a Department of Defense-University Research Instrumentation Program (FY 1983) grant to the University of Florida. It also includes a concise summary of the research projects on which the equipment has been or will be used.</p> <p style="text-align: center;">A</p> <p style="text-align: center;">DTIC FILE COPY</p> <p style="text-align: right;"> DTIC ELECTE S OCT 08 1986 D </p> | | | |
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DEPARTMENT OF ENGINEERING SCIENCES
AEROSPACE ENGINEERING
APPLIED MATHEMATICS
COASTAL AND OCEANOGRAPHIC ENGINEERING
ENGINEERING MECHANICS
ENGINEERING SCIENCE

24 May 1985

Air Force Office of Scientific Research
Directorate of Aerospace Sciences
AFOSR/NA Bldg. 410
Bolling AFB, DC 20332

ATTN: Lt. Col. Lawrence D. Hokanson

SUBJECT: Final Report on Grant No. AFOSR-83-0293 DoD University Research
Instrumentation AUTOMATED MECHANICAL TEST AND ENVIRONMENTAL CONTROL
EQUIPMENT AND DATA ACQUISITION AND ANALYSIS EQUIPMENT, L.E. Malvern
and C. Ross, C. Sun, University of Florida.

Dear Col. Hokanson:

The period of the subject grant expired on 31 March 1985 in accordance with a no-extra-cost extension granted 22 February 1985 to allow time for delivery of the environmental chamber, which had been delayed in manufacture. All the equipment requested under the grant was received at the University of Florida before the expiration of the grant.

This brief report is submitted in fulfillment of the requirement on page two of the grant to provide sixty (60) days after completion a report "which will identify the equipment actually acquired (although it might vary with that described in the grant) by name, manufacturer where possible, and cost, and describe any special circumstances regarding the acquisition or changes to the equipment list."

Following this introductory letter, the report is divided into three sections: I. Concise Description of Equipment Provided and its Intended Research Use, II. Detailed List of Equipment Actually Acquired, and III. Concise Summary of the Research Projects on which the Equipment Has Been or Will Be Used.

The equipment actually acquired is almost exactly that proposed. Some slight variations in detail because of item availability will be noted in Section II. Slight increases in costs of two items were fortunately offset by a decrease in the cost of the test control and data processor for the biaxial test facility. If there is any question about the equipment procurement or its research use, please contact me. The equipment will be of great value to our research programs at the University of Florida, and it is already being used in DoD research. Thank you very much.

Sincerely yours,
Lawrence E. Malvern
Lawrence E. Malvern, Principal Investigator

FLORIDA'S FIRST UNIVERSITY

EQUAL EMPLOYMENT OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

I. CONCISE DESCRIPTION OF EQUIPMENT PROVIDED AND ITS INTENDED RESEARCH USE

Automatic mechanical test and environmental control equipment and data acquisition and analysis equipment for use with an existing MTS 809 biaxial test system were acquired. The MTS 463 Controller/Processor system will be used for military research on composites and metals and for other University research programs, including the training of graduate students. It provides test control, programmed paths and time histories, digital data storage and manipulation and graphical or printed output and greatly enhances the productivity of the testing facility. The MTS Environmental Chamber will provide humidity control and temperature control for tests on organic matrix composites. Current research on composites is supported both by the U.S. Air Force AFOSR and the U.S. Army ARO and additional researches are being planned.

A transient data acquisition and analysis system was also acquired, consisting of a four-channel digital storage oscilloscope and a microcomputer, printer and plotter. The Nicolet 4094 digital oscilloscope has already had extensive use as a transient recorder for data acquisition with a 75-mm diameter Split Hopkinson's Bar System under an AFOSR contract on the dynamic response of concrete. Each of the four channels has a 12 bit, 2 MHz digitizer. Signals are stored in memory and can then be displayed, time-shifted for comparison or addition, integrated or differentiated and transferred to disk or to the microcomputer for further analysis. The DEC microcomputer features 10 megabytes of Winchester disk storage and 512 kbytes of CPU, providing enough local computing capability for data manipulation, statistical analysis, or comparison with predictions of theoretical models. With the LA-100 Letter Printer and the Cleveland Codonics graphics terminal it will provide for speedy editing and output of graphical and printed results.

Ballistic impact studies on composite plates under a current U.S. Army ARO contract have also used the transient recording system. See the list of current and contemplated research programs in Section III.

II. DETAILED LIST OF EQUIPMENT ACTUALLY ACQUIRED

Except as noted, item numbers match the numbers in the original proposal. Items 1 to 4 comprise the system for automated mechanical test and environmental control and data analysis and acquisition with the existing MTS biaxial testing system. Items 5 to 10 make up the transient data recording and analysis system for use in dynamic and impact testing.

1. MTS Data/Control Processing System

(includes Items 1 and 2 of original proposal, supplied by MTS Systems, Inc., although some components were manufactured by others)

Estimated cost \$103,370. + 2,680. = \$106,650.

Total Actual Cost \$95,800

Less University of Florida Cost Sharing \$44,384.

Net Cost to DoD

\$51,416.

System includes:

- A. MTS Model 490.21 Console and interface connections.
- B. DEC Micro PDP-11 with 10 megabyte Winchester.
- C. Two MTS 468.34 Hardware Segment Generators.
- D. MTS 468.44 A/D converter, 16 channels.



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| E. MTS 468.54 Dual Mode Switch Module | |
| F. System Software. | |
| G. Dual Floppy Disk Drive, DEC RX 50. | |
| H. System Software. | |
| I. MTS Graphics Package, including | |
| 1. Modified Tektronix 4925 Graphics Terminal | |
| 2. Tektronix 4611 Hardcopy Unit | |
| 3. Graphics Software. | |
| J. Two MTS 440.32 Feedback Selectors (Item 2 of proposal). | |
| 2. MTS Mechanical/Torsional Grips | Actual Cost \$2,500. |
| (usable in the environmental chamber of Item 3 | |
| at temperatures up to 350° F). Item 2 of the | |
| original proposal was included in Item 1.J of this report. | |
| 3. MTS Temperature/Humidity Chamber | |
| Estimated Cost \$40,000. | Actual Cost \$45,000. |
| provides closed-loop control of both | |
| temperature and humidity. | |
| 4. (Item 4 of original proposal) D/A converter for | |
| remote control of temperature setpoint of Item 3 | |
| was not acquired. Temperature will still be | |
| automatically controlled, but setpoint will be | |
| entered manually. | |
| 5 and 6. Nicolet 4094-2 Digital Storage Oscilloscope | |
| with two Nicolet 4562 2-channel plug-ins and a | |
| Hewlett-Packard HP7470A Digital Plotter. | |
| Estimated Cost \$14,800. | Actual Cost \$18,653.20 |
| 7. DEC Microcomputer 11E23-RE System and software | |
| Estimated Cost \$9,765. | Actual Cost \$10,931.70 |
| 8. DEC LA 100 Printer Cost \$1045.56 | |
| and Cleveland Codonics CDN 1220 | |
| Graphics Terminal Cost \$2040.20, substituted | |
| for the DEC GIGI graphics terminal proposed, | |
| since GIGI was not available. | |
| Total estimated cost \$3,935. | Actual Cost \$3,352.44 |
| 9. VADIC 3451PA MODEM Estimated Cost \$785. | Actual Cost \$680. |
| 10. TOPAZ 70303 1 KVA Power Conditioner | |
| Topaz Electronics, San Diego, CA. | |
| Estimated Cost \$550. | Actual Cost \$613.91 |
| <hr/> | |
| TOTAL EQUIPMENT COST TO DoD | \$133,147.25 |

III. CONCISE SUMMARY OF THE RESEARCH PROJECTS ON WHICH
THE EQUIPMENT HAS BEEN OR WILL BE USED

A. Current Research Projects.

The transient recording system (Items 5-10) has been used extensively on three military research projects.

1. U.S. AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

AFOSR F49620-83-K-007

DYNAMIC RESPONSE OF CONCRETE AND CONCRETE STRUCTURES

L.E. Malvern and C.A. Ross

A new 75-mm-diameter Split Hopkinson's Bar (SHPB) System built under the AFOSR contract has been used to investigate strain rate effects on the strength of concrete by testing plain concrete specimens at strain rates from about 5 s^{-1} to 120 s^{-1} . The four-channel transient recording system has been used to record the pressure bar strains and also the strains in the specimen measured by two gages mounted on its surface. The Nicolet system is programmed to do time shifting and addition or subtraction of two signals, as well as integration, smoothing and/or differentiation of the signals, which are then plotted by the Hewlett-Packard digital plotter. This system has been invaluable for the data acquisition and analysis and has greatly expedited the research program, which has already produced significant results that have been published in the Proceedings of two conferences. The DEC Microcomputer was the last part of the transient recording system received and is only now beginning to be used for further analysis of the results.

2. U.S. ARMY RESEARCH OFFICE

ARO DAAG 29-83-K-0107

DELAMINATION SENSING AND MODELING IN LOCALIZED IMPACTS ON FILAMENT-REINFORCED LAMINATED PLATES.

L.E. Malvern, C.A. Ross and C.T. Sun

The four-channel transient recording system, along with two other two-channel recorders has been used to record transient surface strains and deflections resulting from central impacts on composite plates by ballistic impactors fired from a gas gun. The microcomputer will be used to analyze the results in this continuing investigation of damage mechanisms in impacted glass/epoxy, Kevlar/epoxy and graphite/epoxy continuous filament-reinforced laminated plates. The MTS system has also been used for controlled tension and compression tests of composite coupons.

3. U.S. AIR FORCE

Contract No. F08635-83-C-0136, Modification No. P00004 (Task Order 84-1) issued by AD/PMR, Eglin AFB, FL (Technical monitor AFESC/RDCS, Tyndall AFB, FL) HYPER STRENGTH CEMENT TESTING

L.E. Malvern and R.L. Sierakowski

The new SHPB system described in 1., as well as an older small system have been used for compression testing of samples of a new material that was being evaluated for possible use by the Air Force. The testing program is completed and final report is in preparation.

B. Future Research Planned or Contemplated.

Preliminary exploratory testing of composites under controlled thermal and moisture environments is scheduled to begin as soon as the recently received MTS environmental chamber is fully operational with the existing MTS tension-torsion testing machine and Data/Control Processor. After the exploratory program has verified capabilities, a proposal will be prepared for a research program on environmental effects on strength, stiffness and damping.

Exploratory testing is also under way this summer on tension/torsion of thin-walled tubular specimens of stainless steel. A research proposal will be prepared dealing with strain rate and loading path dependence of the plastic deformation.

Part of the transient recording system is being used in connection with research on the destruction of kidney stones by focused shock waves. The research being performed deals with simulated stones under controlled laboratory conditions, and is being carried out in cooperation with personnel of the University's Medical Faculty.

A proposal is in preparation to submit as a part of the Strategic Defense Initiative research. It will deal with the effects on the mechanical properties of composites produced by various surface treatments of the fibers from which the composites are fabricated. The mechanical testing will make use of the MTS Data/Control Processing System.

Additional research programs dealing with the dynamic deformation of metals and composites (including concrete) will be planned as the current research programs approach completion.

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